FINDINGS AND RECOMMENDATIONS

IDAHO TRANSPORTATION FRAMEWORK PROJECT

Draft 1.0

Part of the Idaho Spatial Data Infrastructure Initiative

Note: This is a preliminary draft with initial recommendations for review and comment by project participants. All recommendations are subject to revision based on reviewers comments. Specific notes to reviewers are highlighted in yellow

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1. PROJECT BACKGROUND

1.1 Project Initiation and Objectives

The Idaho Transportation Framework Project, initiated in mid-2009 has the primary goal of creating and maintaining a seamless, GIS-based transportation data layer for the entire state. This project is being carried out under the auspices of Idaho's Transportation Technical Working Group (TTWG) and is being financially support by a 2009 Category CAP Grant from the Federal Geographic Data Committee (FGDC). See www.fgdc.gov/grants for more information about this grant program. This project focuses on road centerline Framework data but acknowledges other transportation modes (waterways, railroad, air) that are part of the Transportation Framework data theme as defined by the FGDC and the work of the TTWG. The statewide road centerline data, which is the subject of this project, will be referred to as the Idaho Roads Framework. In large part, this project builds on past and ongoing activities that contribute to the development of a GIS-based statewide road centerline data layer that can serve the needs of multiple organizations and user groups.

Specific objectives of the project include:

- Prepare a road transportation data model and data dictionary with the structure and content that supports business and application needs of all user groups
- Provide recommendations on the development of the statewide road transportation database taking into account existing sources of road network data
- Define and work to achieve consensus on data stewardship roles and data maintenance procedures so that the statewide road transportation is regularly updated as actual conditions change (new road development or road closures)
- Provide recommendations on the implementation and use of a Linear Reference Model (LRM) that is compatible with the road transportation data model and data maintenance process

1.2 Project Participants and Roles

This project is coordinated and managed by Bruce Godfrey, CAP Grant Principal Investigator and GIS Specialist at the University of Idaho (in charge of Idaho's GIS clearinghouse, INSIDE Idaho). The TTWG is the main sponsor of this project and the following individuals have been key project participants:

- Brian Emmen, GIS Manager, Idaho Transportation Department
- Frank Roberts, GIS Manager, Coeur d'Alene Tribe
- Dave Christianson, Kootenai County GIS Manager and Transportation TWG Chair
- Gail Ewart, Idaho Geospatial Information Officer
- Scott Van Hoff, Idaho's USGS Geospatial Liaison

Peter Croswell, President of Croswell-Schulte IT Consultants, has been retained to provide consulting support.

1.3 Project Tasks and Summary of Status

Project work has been organized into the eight tasks summarized in Table 1. A detailed project plan with subtasks and projected timing may be found at http://insideidaho.org/geodata/frameworkPilot/transportation/2009_FGDC_CAP_grant/projectPlan.pdf.

Table 1
Task Summary-Idaho Transportation Framework Project

Task #	Task Name	Description	Accomplishments (as of 12-31-2009)
1	**PROJECT MANAGEMENT AND ADMINISTRATION**	All activities relating to administration of the CAP grant and project planning, tracking, reporting and communications	• Project plan prepared and updated • Grant reporting to FGDC prepared xxxx • Regular email and conference call communications
2	**ASSESSMENT OF STATUS OF SEPARATE TRANSPORTATION DATA EFFORTS IN IDAHO**	This task focuses on the status of existing systems/projects in Idaho that involve the collection and maintenance of road data. Includes a summary status, database description, geog coverage, and obtaining application design/data model documentation	• Situation assessment form prepared by Croswell and distributed by Godfrey to key parties (ITD, LHTAC, federal/state agencies, local governments) • Situation assessment results gathered and compiled by Godfrey
3	**GATHER AND EVALUATE OTHER STATEWIDE GIS TRANSPORATION DATA PROGRAMS**	Examine transportation data models and data stewardship programs in other statewide systems to identify approaches that may be implemented in Idaho	• Information gathered from state transportation framework programs in AR, OH, MT, ND, TN, WA, WV • Prepared summary of lessons learned and best practices for transportation framework data management
4	**CONDUCT DATA MODEL NEEDS ASSESSMENT**	Following Task 2 situation assessment conduct a more detailed assessment of data model and data stewardship needs.	• Needs survey form prepared by Croswell with input from Godfrey and Christianson • Survey form distributed by Godfrey and responses forwarded to Croswell • Croswell tabulated survey responses and reviewed results with Godfrey and Christianson
5	**REVIEW AND PROVIDE INPUT FOR ILRM DEVELOPMENT**	Meet with ITD and become involved as a participant (review and comment role) in their current LRM design project being managed by Cambridge Systems	• Completed initial review of ITD LRM documents • Croswell examined LRM status in other states
6	**TRANSPORTATION DATA MODEL AND DATA DICTIONARY DEVELOPMENT**	Preparation of a data model and data dictionary for a common, statewide transportation theme	• Evaluated data models from Idaho sources and from other states • Prepared initial recommendations for an Idaho road centerline data model
7	**DATA SOURCES, STEWARDSHIP ROLES, AND ONGOING MAINTENANCE**	Decide on the specific hardware configuration to support long-term and short-term needs. Select, install, and configure hardware for initial needs during GIS development.	• Croswell has collected data on stewardship approaches in other states and discussed preliminary ideas with Godfrey and Christianson
8	**PROJECT CLOSE OUT**		

2. SITUATION ASSESSMENT OF ROAD TRANSPORTATION DATA MANAGEMENT

2.1 Information Gathering

To establish a baseline of information regarding the current state of road transportation data development and maintenance in Idaho, a situation assessment was conducted. Status information was gathered from individuals of selected organizations in the state and the responses provided a good picture of current road-related data activities in the state. Survey responses were requested from known state and federal agencies and a representative sample of local governments involved in GIS-based transportation data collection. The situation assessment gathered information on existing transportation infrastructure databases, geographic area of coverage, file formats, update process and frequency, and other status information. See Appendix A for more details about the information gathered. Situation assessment information was gathered from the following organizations:

- Idaho Transportation Department
- Local Highway Technical Highway Assistance Council (LHTAC)
- Idaho Bureau of Homeland Security
- Integrated Road Centerline Project
- Idaho Department of Lands
- Kootenai County
- Fremont County
- Nez Perce County
- Bonner County
- Madison County - City of Rexburg
- City of Nampa
- Coeur D'Alene Tribe
- U.S. Forest Service
- U.S. Bureau of Land Management-Idaho State Office

2.2 Summary of Situation Assessment Results

The situation assessment was conducted in the initial stages of the framework project to provide a picture of current transportation data collection and management in Idaho as a basis to evaluate future needs. This situation assessment reveals that there are multiple organizations have been developing maintaining road-related GIS databases—some of which are statewide and others covering a portion of the state. The details of the situation assessment responses can be accessed at: http://insideidaho.org/geodata/frameworkPilot/transportation/2009_FGDC_CAP_grant/situationAssessment.xls. The main findings from this situation assessment are summarized as follows:

- The Idaho Transportation Department is a primary source of statewide transportation for state agencies, some federal agencies, and other organizations including LHTAC, State Bureau of Homeland Security, US Bureau of Land Management, xxx. The ITD maintains a GIS-based statewide transportation centerline database that includes all Interstate highways, U.S. and State routes, and selected local roads and streets (streets/roads with a designated ITD functional class, those for which annual traffic counts are collected, and those with an ITD maintained bridges). All local roads and streets are not captured and maintained by ITD but the number of local roads and streets including in the ITD GIS database varies depending on the local area.

- The state's Local Highway Technical Assistance Council (LHTAC) as part of its mission to support local highway districts and jurisdictions in utilizing available resources for road improvements has been collecting additional road centerline GIS data. This data collection, for local jurisdictions with populations 5,000 and below, is currently being conducted through a GPS-equipped vehicle data collection program.
- The Integrated Road Centerline Project now has participation from 20 counties providing high quality and accurate road centerline data and attribution. INSIDE Idaho uses custom built tools to import and normalize the data to a common data model (centerline attributes) developed cooperatively with a number of local governments in 2006. A process has been put in place to get data updates from the counties and incorporate the data into the integrated layer. For areas of the state without county participation, less accurate and timely Census TIGER data is used.
- There are a number of local governments, with active GIS programs which are maintaining GIS-based transportation data. Based on responses from a sample of seven city, county, and tribal governments and information on participating local governments in the Integrated Roads Centerline Project, it is estimated that xxx counties****
- The most common format for maintaining transportation centerline data is the ESRI geodatabase. All of the organizations included in this situation assessment use this format and in many cases generate derivate GIS database products (e.g., Shape Files)
- The State E911 program **need to gather information on status of work on MSAGS by the E911 Commission and future plans in database support for emergency response
- There is currently no active use of a statewide GIS-based Linear Reference Model. The ITD does maintain a mainframe-based transportation asset database tied to highway log points but there is no GIS interface. The ITD has conducted a detailed study on LRS needs and design issues and is evaluating options for implementation of an enhanced GIS-enabled linear reference system.

3. IDENTIFICATION OF ROAD TRANSPORTATION DATA NEEDS AND CURRENT PRACTICES IN IDAHO

Following the situation assessment described in Section 2, a more detailed survey of needs and current data development and data management practices was conducted with selected organizations. The survey gathered information on:

- Application needs
- Priority for different road types
- Positional accuracy needs
- Road centerline segmentation rules
- Road centerline attributes and road-related data needs
- Road data update procedures

Survey forms (see Appendix B) were returned from the following organizations:

- Idaho Transportation Department
- Idaho Department of Lands
- U.S. Bureau of Land Management
- Coeur D'Alene Tribe
- Kootenai County
- Fremont County
- U.S. Forest Service-Payette National Forest
- Nez Perce County
- Bonner County
- City of Nampa

The full results of the survey may be accessed at http://insideidaho.org/geodata/frameworkPilot/transportation/2009_FGDC_CAP_grant/needsSurvey.pdf. Summary counts for the different survey questions are presented below in Tables 2 to 7. Summary observations about the survey results include:

- Applications that require road centerlines and attributes span a large range but there is a general consensus that, in addition to support for general transportation map display and generation, the Idaho data model should support: a) address matching and address-based incident mapping, b) Emergency planning and dispatch, c) Asset management and maintenance, and d) transportation planning. See Table 2.
- There is very strong consensus that a road centerline database should include all public roads (interstate highways, U.S. routes, state routes, county roads and highways, highway ramps, and municipal streets. The consensus also includes private roads and long driveways. There is some question about the need to include all roads on federal lands (by non-federal organizations) but comments indicate that these roads are fairly high-priority. See Table 3.
- Positional accuracy needs show some variance but most respondents indicated that Moderate Accuracy (5 to 20 feet) was acceptable—with comments that an accuracy level at the lower end of this range (5-foot) is desirable. Several respondents supported a goal for higher accuracy (1 to 5 feet) using high-resolution orthoimagery or GPS-based data capture. See Table 4.
- In most cases, respondents indicate that divided roads (with a median) are represented with two centerlines.

- Responses about road centerline segmentation rules show great consistency in segment breaking at: a) at-grade intersections, b) changes to road name or route number, and government jurisdiction boundaries. Some respondents indicated a rule for breaking a segment of rural road, between actual intersections when those intersections are widely spaced. See Table 5.
- Only about half of the respondents provided information about rules for handling centerline segments for "special road configurations" (e.g., highway ramps, cul-de-sacs, loop roads, traffic circles). The survey results suggest that there is not consistency of these "geometry rules" and that they in most cases are not documented in writing indicating that a statewide road centerline standard should include reference to these cases and how they should be depicted.
- Respondents provided information about needs for additional road-related map features associated with the centerline. Local governments were unanimous in expressing a need for site addresses. Most of the respondents indicated a need for mileposts and for bridges and overpasses. The largest single organization maintaining road information, the ITD, has a primary need for locating all highway assets that they maintain. See Table 6.
- Responses to the question of priority for centerline attributes showed a significant variance when tribal and local governments are examined separately from state and federal agencies. In addition to attributes on road/street names and route numbers, local and tribal governments indicating a very strong need for: address ranges, road jurisdiction, road classification. State and federal agencies indicated high priority need for: log (mile marker) points, road classification, road jurisdiction, surface type, and maintenance status. There were lower than expected scores (average of 4 or less) for several centerline attributes including: alternate street names and route numbers, emergency service zones, road direction and cardinality flags, number of lanes. But these attributes were scored high by several respondents Also there was a low response for Linear Reference Model Route indicating that, at this time, few of the respondent organizations are using an LRM to support location of road assets and events. Establishing an LRM integrated with GIS remains a major priority with the ITD. See Table 7.

Table 2-Road Related Application Needs

(number of respondents identifying each application area)

Application Area	# of responses
Transportation Map Generation	9
Address Matching/ Incident Mapping	7
Emergency Dispatch/Planning	7
Maintenance/Asset Management	8
Route Planning	4
Accident/Safety Planning	4
Transportation Analysis/Planning	6
Other: Timber management	1

Table 3-Road Type Priority

(average priority based on scores of 0 to 10)

Road Type	Average Priority Score
Interstate HWY	5.5
State Highway	7.0
County Highway	7.3
Local/Municipal Street	6.7
Roads on Federal Lands	7.3
Private Roads	6.4
Other: Rural County roads other than HWYs	7.0
Other: Trails, 4-wheel drive/snowmobile routes, river routes	6.0

Table 4-Positional Accuracy Needs

(number of respondents identifying each accuracy category)

Accuracy Level	# of Responses
Very High (<1 foot)	1
High (1 to 5 foot)	3
Moderate (5 to 20 foot)	8
Low (20 to 50 foot)	0
Very Low (>50 foot)	0

Table 5-Rules for Road Segmentation

(number of respondents identifying each segmentation rule)

Segmentation Rule	# of Responses
Intersections	8
Jurisdictional Boundary	4
Change of road name or route #	9
Zip Code boundaries	3
Water crossing	0
Other: Surface Change	1
Other: Address blocks for stretches w/o intersections	1

Table 6-Need for Road-related Data/Features

(number of respondents identifying each application)

Road-Related Feature	# of Responses
Site Addresses	6
Mile Posts	8
Traffic Signs/Signals	4
Bridges/ Overpasses	8
Other: Speed limit	1
Other: All HWY assets	1
Other: Gates, culverts, route signs	3
Other: Jurisdiction, surface type, capacity, status	1
Other: Extent of County Maintenance	1

Table 7-Road Centerline Attribute Priority Scores from Idaho Survey Respondents

(cumulative and average priority scores—based on respondent scores of 0 to 10. Blank entries given a score of "0" indicating no need for the attribute)

Centerline Attribute	Cumulative Priority Score	Average Priority Score	Average Score for Local Gov't	Average Score for State/Fed. Agencies
Segment ID (primary key)	56	6.2	8.0	4.0
Alternate Segment ID	14	1.6	2.8	0.0
Primary Street Prefix	47	5.2	8.0	1.8
Primary Street Name	66	7.3	8.0	6.5
Primary Street Type	47	5.2	8.0	1.8
Primary Street Suffix	47	5.2	8.0	1.8
Route or Local Road #	52	5.8	4.8	7.0
Alternate Street Names	34	3.8	5.4	1.8
Alternate Route #s	25	2.8	2.8	2.8
Post Direction	39	4.3	6.4	1.8
Left From Address	47	5.2	8.0	1.8
Left To Address	47	5.2	8.0	1.8
Right From Address	47	5.2	8.0	1.8
Right To Address	47	5.2	8.0	1.8
Left Postal ID	29	3.2	5.2	0.8
Right Postal ID	29	3.2	5.2	0.8
Left City	27	3.0	5.2	0.3
Right City	27	3.0	5.2	0.3
Left County	18	2.0	3.4	0.3
Right County	18	2.0	3.4	0.3
Right Community[1]	21	2.3	4.0	0.3
Left Community[1]	21	2.3	4.0	0.3
Left Emer. Service Zone	27	3.0	5.2	0.3
Right Emer. Service Zone	27	3.0	5.2	0.3
Number of Lanes	34	3.8	4.6	2.8
Reverse Direction (Y/N)[2]	28	3.1	4.4	1.5
Divided Road (Y or N)	22	2.4	3.2	1.5
Flip Geometry Flag[3]	28	3.1	3.2	3.0
Left Side Odd (Y/N)[4]	21	2.3	3.6	0.8
Map Length[5]	35	3.9	2.4	5.8
3D Length[5]	28	3.1	2.2	4.3
LRM ID6	25	2.8	3.4	2.0
Beginning Log Point	42	4.7	3.6	6.0
Ending Log Point	42	4.7	3.6	6.0
Cardinal (Y/N)[7]	21	2.3	3.0	1.5
Direction Traveled[8]	29	3.2	4.6	1.5

Jurisdiction of Road	59	6.6	6.4	6.8
Surface Type Code	59	6.6	5.8	7.5
Road Classification	63	7.0	6.6	7.5
Maintenance Status	55	6.1	5.6	6.8
Edit or Update Date	53	5.9	5.0	7.0
GIS Data Steward	67	7.4	8.0	6.8
Use Restriction	50	5.6	5.2	6.0
Other: Speed Limit	5	0.6	1.0	0.0

Footnotes:

[1]Any community or place name different from FIPS municipality,

[2]Y means that ascending log points does not corresponding to direction of the segment geometry (digitized direction) in the GIS database

[3]Code to indicate that the geometry (digitized direction) of the segment should be flipped

[4]If Y, left side of street has odd number addresses, if N, left side has even addresses

[5]Map Length is length measured from a map source. 3D length is actual traveled distance (on which log points are based)

[6]The Linear Reference Model route number for the segment

[7]Y Indicates that the segment follows the standard rule for ascending log points (increasing W to E and S to N)

[8]One-way, One-way non-Cardinal (direction of travel is opposite that of log point progression), or Bi-directional

4. TRANSPORTATION DATA MANAGEMENT PRACTICES IN OTHER STATES

Project consultant Peter Croswell reviewed statewide transportation data programs in a number of other states. This review included the acquisition and evaluation of documentation from the state programs and in person or phone interviews with the state project managers. The purpose was to examine data models, organizational and project management approaches, and practices in place for data compilation and ongoing data maintenance. The following states were included in this review: Arkansas, Ohio, Montana, North Dakota, Tennessee, Washington, and West Virginia. These are not the only states that currently have a statewide transportation data program but they represent many of the most effective programs in the USA and provide a representative sample to help identify technical design choices and practices that make sense for Idaho.

4.1 Summary of State Programs Reviewed for this Project

ARKANSAS:

Name of Program: Arkansas Centerline File Program (standard approved by the Arkansas State Land Information Board)
Web Site URL: www.gis.state.ar.us/Programs/Programs_current/ACF_index.htm
Contact Name(s): Learon Dalby, GIS Program Manager, Arkansas Geographic Information Office
Program Background: Work on the standard was initiated in 2000. It was driven by a recognition that multiple federal, state, and local organizations had a need for and in some cases were developing and maintaining road transportation databases without any common standard. The ACF program is designed to compile a standardized statewide road centerline GIS map data layer that can be used by all levels of government, the private sector and individuals. The ACF Program is unique in that the entire dataset is built from many different local source (city and county) datasets using a common standard. The State of Arkansas does not create or develop any data. The State simply integrates the various local sources into a common format in a standardized and consistent manner across jurisdictional boundaries. The centerline standard, documented in the 2002 document identified above is an approved standard and includes general guidelines for data compilation and a description of attribute data fields for centerline segments.
Data Model Summary: The centerline standard, documented in the 2002 document identified above is an approved standard and includes general guidelines for data compilation and a description of attribute data fields for centerline segments. The data model has a basic set of attributes that support a basic cartographic representation of the road network and address-based applications—it includes addresses ranges, jurisdictional identifiers, and other basic information. No firm rules have been defined for a common centerline geometry (accuracy, segmentation, handling of divided roads, or other special road configurations).
Database Development and Maintenance Approach: The statewide centerline network has been compiled from a number of available sources by the state Geographic Information Office. An ongoing data maintenance program has been established that relies on updates from County governments (mainly the E911 bodies in each county). The goal is to get monthly data updates from the counties but in practice, updated data often comes in less frequently. Getting data updates from on any regular basis from some counties is difficult. There is no unified positional accuracy requirement of designated source or approach for data update. The Centerline File standard states that the primary source will be USGS orthophoto quarter-quad files but compilation from higher-resolution orthoimagery and GPS data capture is encouraged. There are plans to develop a Web-based maintenance tool for use by the counties but this is not yet in place.

OHIO:

Name of Program: Land Based Response System (LBRS) Program run by the Ohio Geographically Referenced Information Program (OGRIP) in the Ohio Office of Information Technology
Web Site URL: http://ogrip.oit.ohio.gov/ProjectsInitiatives/LBRS.aspx
Contact Name(s): Jeff Smith; (OGRIP); Dave Blackstone, Ohio DOT; Ron Cramer, DDTI (contractor for GPS road data collection)
Program Background: LBRS is a state government managed project, in place for nearly 10 years, established for county participation in the collection and ongoing maintenance of street centerlines, addresses, and other road-related assets. It is a participatory program with partial state funding in which counties opt (through a memorandum of agreement) to carry out the data gathering using specifications of the LBRS program and agree to provide updates. The program has participation of multiple state agencies. OGRIP and the Ohio DOT play lead roles in providing technical support to participants. At this time, 70 out of 88 counties in the state are participating in the program and many of the others in the process of approving an LBRS memorandum of agreement or are considering becoming a participant.
Data Model Summary: The LBRS program includes data models designed for the capture of street and road centerlines, a wide range of attributes for centerlines, site addresses, and road-related point features (e.g., milepost signs, landmarks). The data model for centerlines is extensive and includes R/L address ranges and jurisdictional information as well as attributes that support road-related asset management and emergency management (number of lanes, functional class, road jurisdiction, posted speed limit). The centerline data model includes a number of fields to identify the cardinality of a segment (direction of addressing and mile point progression). There is also route information to allow the model to be used with a linear reference model and a field for 3-D road length (traveled distance). Specifications for LBRS data collection include mature and detailed specifications on centerline geometry include rules for segment breaks and for handling a range of special road configurations (cul-de-sacs, ramps, traffic circles).
Database Development and Maintenance Approach: Detailed LBRS specifications for data capture are required to be followed by counties participating in the program (and contractors hired to do the work). The specification is designed for data capture by GPS (specially equipped vehicles with GPS, video systems, and other equipment). Since the beginning of the program, procedures and tools for data collection and post processing, for segment, site address, and landmark features, have been perfected. Data collected from the vehicle (driving all roads in the jurisdiction), is processed by an operator that has access to ancillary sources (e.g., ortho). The resulting data sets may be used with different GIS software. The Ohio DOT is responsible for ongoing update of data for state maintained roads (Interstates, U.S routes, and state routes). Through a term in the LBRS memoranda of agreement, counties are responsible for providing updated data for local roads. The Ohio DOT has the lead role in working with the counties and has a partnership with a designated entity in the county which may be a GIS Office, the E911 office, or the County Engineer's Office. The DOT accepts the data, performs QA on road geometry, topology, and segment attribution. The DOT does not perform QA checks to validate that street names and addresses are correct. Data may be provided by the counties, at least on an annual basis, in any of several formats (Shape Files or AutoCAD dwg files are common). A contractor in Ohio, DDTI, which has become the principal provider of data collection services also provides a Web-based hosted GIS and provides Web-based tools for counties to update data.

MONTANA:

Name of Program: Transportation Framework Theme project. Part of the Montana Spatial Data Infrastructure Program (MSDI) and the Transportation Working Group
Web Site URL: http://giscoordination.mt.gov/transportation/msdi.asp
Contact Name(s): Joshua Dorris, Transportation Framework Theme Lead, MT Dept. of Administration, Information Technology Services Division
Program Background: The Transportation Framework Theme project is part of Montana's spatial data infrastructure program that includes other framework data layers. A data model and update process was designed with input from multiple state agencies and local governments. The intent was to include all roads (interstates, federal and state routes, local roads and streets) and to keep the statewide updated. New roads are constantly being built and upgraded, seasonal closures affect certain routes, road names and address ranges change, and road maintenance is a continual occurrence. The project received support and funding largely because of a business case showing benefits for emergency management and response
Data Model Summary: A data model was created that defines attributes for centerline segments. It is designed for implementation with within ESRI's geodatabase architecture. In addition to roads, the data model accommodates other transportation modes (e.g., RR, Trails). This provides for a core set of attributes that include address ranges, jurisdictional information, and other physical road characteristics (surface type, width, lanes, etc.). No specific rules have been defined for road centerline geometry (segmentation, positional accuracy, handling of special road configurations).
Database Development and Maintenance Approach: The goal is to make annual updates to the centerline database. The State Dept of transportation is responsible for making updates to Interstates and State routes. Ongoing data update for county highways and local streets relies in part on data provided by county government groups. This works well for counties with active GIS programs (about ten at the current time). Getting updated data from counties without GIS programs is more difficult. Most of these counties are lower population and have slower growth so road changes are less frequent. The state DOT does collects some local road data through GPS collection. Some data for roads on public lands (e.g., state and national forests) are provided by the US Forest Service and State Natural Resources.

NORTH DAKOTA:

Name of Program: North Dakota Statewide Road Centerline Database
Web Site URL: www.nd.gov/gis/resources/standards/070425.html and www.nd.gov/gis/news/20061117.html
Contact Name(s): Bob Nutsch, State GIS Coordinator, Information Technology Department
Program Background: The program began in 2006 when the state's GIS technical Committee commissioned a study to determine the most feasible and cost-effective approach for developing and maintaining a statewide road centerline dataset. This study by Geocomm included a road data inventory, data model and quality standards, implementation approach and funding estimates. The main project stakeholder is the State Dept. of Emergency Services (DES) and the North Dakota 911 Association. A number of state agencies and Association of Counties representatives participated in the study and information was collected from many of the state's counties. Standards and specifications are still in the process of being finalized and work is underway to development a complete statewide centerline dataset with address information and other attributes to support emergency services and other applications. At this time the State DOT is not a major participant.
Data Model Summary: The data model includes a definition of rules for centerline segmentation, topology, and a full set of attributes for centerlines with an attribute description. The centerline attribution is divided into "base fields" (includes street names and route numbers, address ranges, jurisdictional and ESN codes, surface type and some metadata fields).
Database Development and Maintenance Approach: Database development is underway initially using GIS source data available from the counties and aerial imagery. Work involves capture of centerlines and address points. The intention is to include all roads (federal, state, local, and private roads). Target accuracy is one meter, and various compilation and update sources are being considered, including GPS capture. Full procedures and tools for data update have not been put in place yet but it will rely on individual counties with oversight from the state DES. There has been consideration of implementing a Web-based tool to allow local governments to post road and address changes directly to the state centerline database.

TENNESSEE:

Name of Program: Tennessee Information for Public Safety (TIPS)
Web Site URL: http://gis.state.tn.us/tips.html
Contact Name(s): Patrick Melancon, GIS Services, State Office for Information Services
Program Background: TIPS is one part of Tennessee's statewide base mapping program (TNBMP) managed by the State's GIS Services Section of the Office for Information Resources. The initial version of the statewide centerline database was developed in 2007 and is now in an ongoing maintenance and improvement stage. OIR worked with a number of state agencies (DOT, the Emergency Communications Board) and local entities including E911 districts and county and city governments.
Data Model Summary: The data model includes centerline data attribution and metadata. It includes attribution for driveway and trail centerlines in addition to roads. There is also an attribute table for address points. Road centerline segmentation rules call for breaks at intersections, jurisdiction boundaries, and zip code boundaries.
Database Development and Maintenance Approach: The statewide database has been developed based on data from local sources. The state also paid license fees to TeleAtlas to use their compiled centerlines and attribution. The update process relies on information from county E911 districts or local government sources (e.g., GIS offices, Assessors). OIR attempts to get data updates on a quarterly basis although in practice data updates from local sources do not always adhere to the quarterly schedule. OIR accepts the data and performs QA and posting to the state centerline database. At the current time, the state DOT is not a participant in the update process—they maintain a separate centerline file for cartographic purposes but there is interest in involving the DOT in the update of a unified centerline file.

WASHINGTON:

Name of Program: WA-Trans Program
Web Site URL: www.wsdot.wa.gov/MapsData/Transframework
Contact Name(s): Tami Griffin, WA-Trans Project Manager, Washington Department of Transportation
Program Background: Planning began in 2002 under the auspices of the state Geographic Information Council and the state DOT. The project was established to create a statewide transportation dataset for use in Geographic Information Systems (GIS) applications. WA-Trans data can be used in Transportation Planning, Transportation Safety, Emergency Management, Law Enforcement, and other business functions benefiting state and local agencies throughout the state. It also supports statewide the development and maintenance of other Framework layers. A business case was prepared early in the project and work proceeded in the preparation of technical specifications and a data model. At the current time, there is a mature data model, technical specifications, and technical tools for importing data from source custodians. A number of pilot projects have been completed in which data from several regions and work is under way to include additional counties. The WA-Trans project has been carried out as part of a multi-state "pooled fund" effort coordinated by the Federal Highway Authority. A number of state transportation agencies, including the Idaho Transportation Dept. have contributed funding to this effort and have the ability to share in the specifications and technical tools that are developed.
Data Model Summary: A mature data model consists of several tables that allow the capture of attributes for centerline and geometry rules for the centerline segments. The WA-Trans project is concentrating on road centerlines, but the data model allows for capture of data for other transportation modes (RR, Trails). The data model is fairly complex. It includes multiple related tables that separate centerline geometry from centerline segment attributes. There is a table that holds street and road identification, address range and related data, and another table that stores route information supporting the DOT's linear reference system. The data model also includes a large number of metadata fields that document update transactions, data sources, and quality.
Database Development and Maintenance Approach: Database development is currently underway through a number of pilot projects, and the WA-Trans team is in the process of getting additional participation from counties with a goal of building a statewide database. The WA-Trans program has, from its inception, been based on the idea that data sources (local governments and tribal governments) will be the primary sources of data and that there will be no data specifications, data model standards, geometry rules, or accuracy requirements imposed on them for their own use. For this reason, the data model includes extensive metadata to document sources and data quality and sophisticated translators and import tools have been developed to accept data from the varied sources.

WEST VIRGINIA:

Name of Program: Statewide Addressing and Mapping Project
Web Site URL: Project site at: www.addressingwv.org, State GIS clearinghouse at: www.mapwv.gov/
Contact Name(s): Hussein Elkhansa, GIS Manager, WV Department of Transportation; Jennings Starcher, IS Manager, WV Division of Homeland Security and Emergency Management.
Program Background: Mapping of road centerlines and capture of point addresses in West Virginia began in 2001 with the creation of the Statewide Addressing and Mapping Board (SAMB). Funding became available to map centerlines and capture point addresses for the entire state, with a primary objective of supporting emergency management and response for state agencies and local emergency organizations. Centerlines were mapped from one-meter resolution orthoimagery (2003) and the SAMB program developed partnerships with counties to carry out address capture. At this time, most of the counties have completed the mapping and address assignment work. Management of road centerline date and addressing is shared between the state Department of Transportation (road centerlines) and the Department of Homeland Security and Emergency Management (address assignment). The DOT is in the process of improving the accuracy of the initial road centerline data and adding attribution that supports state and local use.
Data Model Summary: The current technical specifications (2008 version) include a number of data tables that define attribution for road centerlines and address points. It also includes general guidelines for the capture of metadata, coordinate system standards, and rules for road segmentation. For road centerlines, the data model includes road and route number identification fields, R-L jurisdictional and emergency service zone designations, and other attributes.
Database Development and Maintenance Approach: Update of data relies on data provided by the state DOT and local governments that are formally participating in the SAMB project. The DOT is responsible for the updating interstates, U.S. routes and state routes. GPS-equipped vehicles are used to capture updated road mileage and attributes on an annual basis (for interstates and state routes). Local roads are the responsibility of county governments, and Web-based tools are available to support updates. The state Department of Homeland Security and Emergency is responsible for updating address information through work with individual counties.

4.2 Summary of Findings, Lessons Learned, and Best Practices in other States

The review of statewide transportation data programs has been helpful in identifying best practices and potential pitfalls that help guide decisions for Idaho in development and management of a statewide Idaho Roads Framework. Key points derived from other states include:

- Define the business focus of the statewide transportation data effort. Is the primary goal to support basic cartographic operations or more sophisticated applications (e.g., road asset management, emergency response, routing, etc.)? This will help guide technical design and decisions on the content and format of the data model. A number of states have prepared good business case documents (Ohio, Washington, North Dakota, and North Carolina).
- Put in place a well-defined and strong entity at the state level with a leadership role and authority to coordinate the effort, develop data standards, and oversee database development and ongoing maintenance
- Make a decision early in the planning and design process about the degree to which individual stakeholders, particularly with local governments, are required to comply with a common statewide set of specifications (road centerline geometry, accuracy, file formats) and data model. Ideally, a high level of acceptance of common standards is best but not always possible given the status of mature GIS programs (maintaining data in formats that do not fully comply with a state standard). The decision about compliance with common

formats and standards will dictate the need for tools and services for import/translation/restructuring of data from individual sources.

- If possible, include key state agencies in the design process and ongoing management. Active participation of several key state entities: the state GIS office, transportation agency, and the emergency management or E911 body greatly increase prospects for a successful effort.
- Include technical specifications that define rules for road centerline segmentation (at what points to break segments) and mapping rules for segmenting special road configurations (divided roads, ramps, frontage roads, cul-de-sacs, loop roads, traffic circles)
- Include clear definition on the types of roads that will be part of the database (Interstate and US highways, roads on federal lands, state highways, county highways and roads, local streets, private roads, long driveways, etc.
- State guidelines for positional accuracy and sources and methodology for centerline capture and update. Identify a minimum accuracy goal and allow data collection using different sources and methods (e.g., heads-up digitizing from orthoimagery, capture from GPS-equipped vehicle). For data capture from orthoimagery, encourage use of high-resolution sources (2-foot pixel or better).
- Define clear responsibilities for ongoing update and for final QA and posting of data. Responsibilities should be split between state agencies (e.g., transportation agency, E911 body) and local entities (county level office). Put in place easy to use tools for the upload of data to the state custodian of the statewide database and provide a Web-based tool for direct data update. Define a schedule (e.g., quarterly) for posting updated data to the statewide database
- Acknowledge that there will be gaps in the update process—particularly with low resourced local governments which do not have the technical capabilities or staff to provide updated data. Assign a role to a state agency (e.g., the transportation agency or state GIS office) to carry out updates for these counties.
- Make sure that the data model has a way to accommodate multiple road names and/or route numbers. It will be necessary to designate a "primary" street name or route number and multiple alternates (sometimes up to five). This can be handled by reserving multiple fields in a primary table (up to the maximum expected number), use of a special "alternate road name/route number table" that can be joining with the main centerline attribute table, or use of a concatenated field with defined delimiter characters).
- If the data set will be used for any routing applications, incorporate ways to define road segment cardinality relationships (one way designation, proper from-to address ranges, adherence to standards for mile post progression, cases in which address progression does not follow the milepost progression).
- Maintain a reasonable set of metadata—most importantly information on source, data quality, updates timing, and organization performing update. Store this metadata in fields reserved in a main centerline attribute table or in a separate joinable table

5. BUSINESS CASE JUSTIFICATION FOR A COMMON STATEWIDE ROAD FRAMEWORK DATABASE

**this section is intended to be a brief "business case" listing main reasons for pursuing a unified approach to building and maintaining a statewide transportation framework database. It will be completed after comments are provided on this draft.

6. INITIAL ROAD CENTERLINE DATA MODEL RECOMMENDATIONS FOR IDAHO

**This section contains preliminary recommendations all of which are subject to modification or revision based on comments from reviewers.

6.1 Components of a Road Centerline Data Model

A GIS-based road centerline data model is an abstraction of the actual road network with a data format and content that makes it useful for a range of applications. A unified model, the goal of this project is one which serves multiple organizations and user groups—recognizing that data needs and applications will vary. As a basis for detailed design and ultimate data capture and maintenance, the data model for the Idaho Roads Framework should consist of the following components:

- Types of roads to include: A domain definition that identifies all types of roads that should be included in the common centerline database (e.g., federal, state, local, private). This domain definition is the basis for any road data capture project or data maintenance program.
- Geometry rules governing centerline depiction: Specifications governing how the centerline of roads will be depicted and formatted. This includes rules that govern: a) break points defining individual centerline segments, b) depiction of complex road configurations (divided roads, ramps, traffic circles, etc.), c) cardinality (from-to direction of segment), d) other geometry or GIS topological rules.
- Expected accuracy and sources for capture and maintenance: Standards governing acceptable (and sometimes preferred) positional accuracy level(s) and sources for compilation and update.
- Attribute data and validation rules: Information captured for each centerline segment for database storage and use in application and associated rules used to validate acceptable values for the attributes.
- Metadata: Descriptive information about the centerline database used to provide information to users. Metadata includes information on content, format, source, data quality, maintenance status, and custodians of the database. Metadata elements may be included in the GIS centerline attribute database or in separate data tables or text files. Metadata included should comply with approved Idaho Geospatial Standards.

Defining and getting consensus on these aspects of the Idaho Roads Framework must begin by recognizing that different user groups have a range of needs and application priorities which will dictate road centerline data format and content. The key is to define a "base data model" with geometry rules, accuracy standards, and data content that meets most of the needs of all user groups and which supports efficient enhancement or restructuring by any user group.

Initial recommendations for data model format and content, based on information examined during this project, are presented in the subsections below.

6.2 Types of Roads, Geometry Rules and Accuracy Standards Recommendations

This subsection provides recommendations for "mapping rules"—guidelines and standards for road centerline data capture and format designed to create consistency in data that is compiled and updated for the road centerline database.

Types of Roads for Inclusion: At a minimum, the following types of roads should be included. This includes all Interstates, U.S., state, and county highways and all local roads and streets. This encompasses all public road functional classes—arterial, collectors, local roads as defined in the FHWA Functional Classification Guidelines (www.fhwa.dot.gov/planning/fctoc.htm). It is highly desirable, but not essential, that private roads be captured and updated as well. Private roads include the following types:

a) Roads maintained on land owned by government entities that are not open for public access (e.g., restricted roads on BLM or USFS lands). Other examples in this category??

b) Roads inside private developments which are not under the jurisdiction of a public entity (e.g., private roads inside apartment complexities, industrial parks, trailer courts, camp grounds, office parks, etc.).

c) Long driveways connecting a public road to one or more residences or other occupied building.

Road Centerline Segment Break Points: At a minimum, end points of centerline segments should be placed at:

a) At-grade road intersections (bridge or overpass points not included).

b) Jurisdictional boundaries (break point where road intersects state, county, or municipal boundaries.

c) Point where primary road name or route number changes.

d) Points at which there is a change between a divided road (two centerlines) and an undivided road (one centerline).

d) Point of change in road functional class **should this be an established rule for centerline breaks??

Individual organizations capturing and maintaining road centerline may break segments at additional defined points including those below as long as metadata is provided that identifies the break points:

- other jurisdictional or administrative boundaries such as zip code boundaries??

- well-defined points between widely spaced intersections (generally ½ mile or more) on rural roads. A well-defined point is one that corresponds to a topographic feature or cultural landmark that can be observed in the field and on source data used for road centerline capture.

Depiction of Divided Roads: Roads that are divided with a median in the center should be depicted as two different centerlines. A general rule for defining a divided road, for depiction with two centerlines, is roads where a left turn is prohibited. Usually, there is a physical barrier (median, guard rail, etc.), but sometimes this is pavement with a marked gore area. Connecting roads and U-turn connections between the divided lanes should be captured…..**(need discussion on how to capture these connection roads)

Digitizing Direction: Centerlines should be digitized in the direction of established cardinality for roads in which cardinality applies (Interstates, US routes, state and county highways). This is the direction of progression in assignment of highway log points. In Idaho, the cardinality rule is low-to-high progression, south-to-north and west-to-east. Note: Some roads might have a cardinality that does not adhere to this standard. For roads with no formal cardinality assigned (e.g., municipal

streets, rural roads), the digitizing direction should correspond to the low to high address progression.

Format Guidelines for Special Road Configurations: The following rules provide guidelines for the capture of road centerlines in the following special cases:

- Traffic Circles: In these cases where there are multiple roads that connect to points on a traffic circle or other geometric shape (e.g., square, rectangle, ellipse) the centerline of that shape should have a unique name and ID. If it has a formal name, this should be assigned. If there is no formal name, the authority for update should assign a name (e.g., name of major street or highway entering the circle or shape with designation of "circle" or "square"). Centerline segments should terminate on the circle's centerline and define individual centerline segments of the circle. A value of "0" should be entered for any centerline attributes of the circle that do not apply.
- Highway Ramp Attribution: All attributes should be populated for entry and exit ramps. From-To identifiers refer to the primary names of the roads on each connecting end of the ramp. Attribute fields that do not apply (e.g., From-To addresses) should be given an attribute of "0."
- Highway Ramp Connection to Intersecting Streets: General rule is to plot a tangent of the ramp's centerline from the point at which the edge of the ramp first joins the connecting road to the connecting road centerline.
- Cul-de-sacs: For cul-de-sacs, for which there is no physical island, terminate the centerline at the center of the cul-de-sac. For cul-de-sacs for which there is a physical island, draw the centerline around the island (right side of island) to a point in front of the last lot or building on the cul-de-sac. **will this work??

Accuracy and Source Guidelines: Organizations that are performing data capture or update of road centerline data that will be used as an input for the Idaho Roads Framework should use methodologies and sources that achieve the highest possible horizontal positional accuracy. Metadata should accompany all data to identify sources and accuracy levels. The goal should be for a minimum accuracy level of 10-feet.* Higher accuracy levels are desired. Sources for road centerline may include: a) medium or high-resolution (1-meter pixel or better) orthoimagery with centerlines captured through a heads-up digitizing, b) large-scale georeferenced subdivision maps or construction drawings, or c) field-based capture using GPS technology (ideally from a specially equipped vehicle with integrated GPS, inertial navigation, and video logging equipment).

*statement of horizontal accuracy compliant with the National Standard for Spatial Data Accuracy (NSSDA, FGDC-STD-007.3) in which accuracy figures are presented as a maximum root mean square (RMS) error in the 95% confidence interval. This RMS error is the average of the set of squared distance differences between points in the data set and independently collected points (representing highly accurate positions). All road centerline data sets compiled for the Framework database do not necessary need to be tested for accuracy if the methods and sources are known to deliver the stated accuracy level.

6.3 Data Content (Attribution) Recommendations for the Road Centerline Database

**This definition of road centerline attribution is the basis for the preparation of a data dictionary that provides format information and an explanation of each attribute. This will be completed after reaching a consensus on attribute content.

Recommendations for road centerline attribution are based on a review of GIS databases in Idaho, the results of the needs survey of Idaho organizations, and an examination of centerline data maintained by other states. Based on the data priority evaluation, recommendations are made for

attributes to include in a statewide common road centerline database. These recommendations identify a "core" (primary) and an "extended" (secondary) set of attributes that should be captured and updated by any organization providing data to the Idaho Roads Framework. The "core" attributes should be considered mandatory and the "extended" attributes are recommended but not mandatory for data organizations generating or updating data.

Table 8 gives a comparison of these sources to examine priority and identify needs and make recommendations for a core set of attributes that should be included in the Idaho Roads Framework. Road centerline attributes are sorted in the order of their combined scores with designation (recommended) on the inclusion of the attribute in the database. Codes for this designation are: "C" (for core attribute), "E" (for extended attribute), and "N" (not included in Framework database).

Table 8- Idaho Roads Framework Centerline Attributes—Priority Evaluation

Note: The following table (next page) presents designations for centerline attributes. These designations are tentative and open for discussion and changes. A question mark is shown in cases where priority is not clear and should be discussed. Several of the attributes with low combined priority scores have been designated as "Core" or "Extended" attributes. The "Comment" field is designated as a Core attribute because it can serve as a type of metadata providing information about the source and import into the Idaho Roads Framework. The "Alternate Segment ID" is designated as a "Core" attribute in case it is needed to keep a record of a separate ID for a road segment used in the original source data before being imported to the Framework database. The "Direction Traveled" attribute is important since it identifies one-way streets—potentially useful in routing applications.

Centerline Attribute	Idaho Integrated Statewide Road Centerline	Idaho Department of Transportation	Arkansas Centerline file	Ohio LBRS	Oregon GIS Transportation Framework Theme	Montana Transportation Framework Theme	North Dakota Road Centerline Database	Tennessee TIPS BMP Data	Washington WA-Trans Program	West Virginia SAMB and DOT	**Number of States Centerline Databases Using Attribute**	**Average Idaho Priority Score** (from needs Assessment)	**Combined Score**	**Framework Attribute?***
Comment		X									**1**	**0**	**1**	**C**
Measure Method[11]		X									**1**	**0**	**1**	**N**
Use Status[10]								X			**1**	**0**	**1**	**N**
Road Label[9]								X		X	**2**	**0**	**2**	**N**
Road Width		?				X					**2**	**0**	**2**	**N**
Cardinal (Y/N)[7]				X							**1**	**2.3**	**3.3**	**?**
Left Side Odd (Y/N)[4]										X	**1**	**2.3**	**3.3**	**?**
3D Length[5]				X							**1**	**3.1**	**4.1**	**N**
Flip Geometry Flag[3]										X	**1**	**3.1**	**4.1**	**N**
Reverse Direction (Y/N)[2]				X							**1**	**3.1**	**4.1**	**?**
Left Postal ID										X	**1**	**3.2**	**4.2**	**N**
Right Postal ID										X	**1**	**3.2**	**4.2**	**N**
Left Community[1]				X				X			**2**	**2.3**	**4.3**	**N**
Right Community[1]				X				X			**2**	**2.3**	**4.3**	**N**
Divided Road (Y or N)		?		X							**2**	**2.4**	**4.4**	**?**
Alternate Segment ID					X	X	X	X			**4**	**1.6**	**5.6**	**C**
LRM ID[6]		x		X					X		**3**	**2.8**	**5.8**	**E**
Speed Limit	X	?		X		X	X	X			**6**	**0.6**	**6.6**	**E**
Left Emer. Service Zone				X			X	X		X	**4**	**3**	**7**	**E**
Right Emer. Service Zone				X			X	X		X	**4**	**3**	**7**	**E**
Direction Traveled[8]		?		X		X	X	X			**5**	**3.2**	**8.2**	**C**
Post Direction	X		?				X				**3**	**4.3**	**7.3**	**N**
Number of Lanes	X	?		X		X					**4**	**3.8**	**7.8**	**E**
Maintenance Status		X			X						**2**	**6.1**	**8.1**	**N**
Left County		?	X	X	X			X	X	X	**7**	**2**	**9**	**C**
Right County		?	X	X	X			X	X	X	**7**	**2**	**9**	**C**
Jurisdiction of Road		?		X					X		**3**	**6.6**	**9.6**	**C**
Use Restriction	X					X		X	X		**4**	**5.6**	**9.6**	**E**
Alternate Route #s		?	X	X		X	X		X	X	**7**	**2.8**	**9.8**	**C**
Map Length[5]	X	?			X	X	X		X		**6**	**3.9**	**9.9**	**C**
Beginning Log Point	X	x		X	X		X		X		**6**	**4.7**	**10.7**	**C**
Ending Log Point	X	x		X	X		X		X		**6**	**4.7**	**10.7**	**C**
Alternate Street Names		?	X	X		X	X		X	X	**7**	**3.8**	**10.8**	**C**
Left City	X	?	X	X	X			X	X	X	**8**	**3**	**11**	**C**
Right City	X	?	X	X	X			X	X	X	**8**	**3**	**11**	**C**
Primary Street Type			X	X	X			X	X	X	**6**	**5.2**	**11.2**	**C**
Surface Type Code	X	?		X		X			X		**5**	**6.6**	**11.6**	**C**
Road Classification	X	?			X	X			X		**5**	**7**	**12**	**C**
Edit or Update Date	X	X			X	X	X		X	X	**7**	**5.9**	**12.9**	**C**
Left State		?	X	X	X			X	X	X	**7**	**6**	**13**	**C**
Right State		?	X	X	X			X	X	X	**7**	**6**	**13**	**C**
Source Information		X	X			X	X	X	X	X	**7**	**6**	**13**	**C**
Left From Address	X		X	X	X	X	X		X	X	**8**	**5.2**	**13.2**	**C**
Left To Address	X		X	X	X	X	X		X	X	**8**	**5.2**	**13.2**	**C**
Primary Street Prefix	X		X	X	X		X	X	X	X	**8**	**5.2**	**13.2**	**C**
Primary Street Suffix	X		X	X	X		X	X	X	X	**8**	**5.2**	**13.2**	**C**
Right From Address	X		X	X	X	X	X		X	X	**8**	**5.2**	**13.2**	**C**
Right To Address	X		X	X	X	X	X		X	X	**8**	**5.2**	**13.2**	**C**
GIS Data Steward	X		X			X	X	X	X		**6**	**7.4**	**13.4**	**C**
Route or Local Road #		?	X	X	X		X	X	X	X	**8**	**5.8**	**13.8**	**C**
Segment ID (primary key	X		X	X	X	X	X	X	X	X	**9**	**6.2**	**15.2**	**C**
Primary Street Name	X	?	X	X	X		X	X	X	X	**9**	**7.3**	**16.3**	**C**
Left Zip Code		?	X	X	X	X	X	X	X	X	**9**	**8**	**17**	**C**
Right Zip Code		?	X	X	X	X	X	X	X	X	**9**	**8**	**17**	**C**

Footnotes:

* Codes for this designation are: “C” (for core attribute), “E” (for extended attribute), and “N” (not included in Framework database)

[1]Any community or place name different from FIPS municipality,

[2]Y means that ascending log points does not corresponding to direction of the segment geometry (digitized direction) in the GIS database

[3]Code to indicate that the geometry (digitized direction) of the segment should be flipped

[4]If Y, left side of street has odd number addresses, if N, left side has even addresses

[5]Map Length is length measured from a map source. 3D length is actual traveled distance (on which log points are based)

[6]The Linear Reference Model route number for the segment

[7]Y indicates that the segment follows the standard rule for ascending log points (increasing W to E and S to N)

[8]One-way, One-way non-Cardinal (direction of travel is opposite that of log point progression), or Bi-directional

[9]Text label used for map annotation

[10]Flag in the database reflecting actual status of the road segment use (Operational, Retired, Proposed, Closed)

[11] Method used to determine length, i.e., measured from linework, linear reference length, etc

7. IDAHO LINEAR REFERENCE SYSTEM RECOMMENDATIONS

** This section will be completed after on-site discussions.

7.1 What is a Linear Reference System

A linear reference system, as it relates to road networks, includes a data model and automated tools for locating events and assets relative to the road centerline network. The LRS works together with a spatial coordinate system to identify point locations and road segments referencing as a linear distance from a starting point or anchor point along defined routes. An LRS, when implemented as part of a GIS, can provide a powerful means to manage and visualize road-based information and support a variety of program requirements (e.g., transportation asset management, pavement management, accident and safety analysis, routing, etc.).

7.2 Linear Reference Model Status in Idaho

**Note: The ITD currently maintains a database system that references highway assets by log points but this has no GIS interface or integration. The ITD has recently conducted an LRS needs study to identify requirements and advantages for migration to a more state-of-art LRS. This needs study which was conducted by the ITD will help from GeoDecisions and this was followed by research project conducted by Cambridge Systematics to provide options for LRS development. Currently, the ITD is evaluating options for LRS development.

7.3 Initial Recommendations for LRS Implementation

8. DATA STEWARDSHIP RECOMMENDATIONS

Data stewardship means the timely update of high-quality data with an efficient approach to make that data available to users. Data stewardship applies to the update of the graphic representation of the centerline network, centerline attribute data, and metadata. Based on the evaluation of needs from Idaho stakeholders and a review of road centerline data maintenance approaches in other states, the following assumptions are made that underlie an effective stewardship program for Roads Framework in Idaho:

- There should be an easily understood data dictionary that explains the meaning and domains of all centerline attributes.
- Clear technical standards governing road centerline geometry (rules for segment breaks, placement of nodes, etc.) should be stated.
- Minimum acceptable positional accuracy, spatial reference information, and file formats should be identified. Minimal horizontal positional accuracy requirements (for acceptance in the statewide unified centerline database) should be at least ten feet with an option for higher accuracy.
- It is critical to have a state agency take a lead role for data update and management of the unified statewide centerline database.
- Regular maintenance of the database will require contributions from multiple organizations. In addition to the lead state agency, this includes designated local government agencies and, very likely, other state agencies. Responsibilities for maintenance need to be clearly defined.
- Building a statewide road centerline database is dependent on getting good quality graphic and attribute data for local roads and streets. The compilation process should draw on ongoing work carried out as part of the Integrated Road Centerline project and data being collected and maintained by the ITD and LHTAC
- While data update must include local government jurisdictions (county and city governments), it can be assumed that some of these local jurisdictions will not have the resources or technical expertise to capture road centerline data and provide regular data updates. Therefore, there must be an approach, resources, and assigned roles for gathering the data on behalf of the local government.
- Metadata should be updated along with updates to the centerline database
- Updates to Idaho Roads Framework must follow a regular schedule for posting the updated data from multiple sources.

**Specific recommendations on stewardship will be made after comments and ideas from project participants are reviewed and after draft stewardship program documents are reviewed.

APPENDIX A: INFORMATION GATHERED IN THE SITUATION ASSESSMENT

Information to Collect

1. Description of current transportation infrastructure databases

- Road centerline data capture: what type of roads? (Interstates, State Hwy, County Hwy, local roads/streets, roads on federal land, private roads)
- Addresses: address ranges, point addresses
- Mileposts
- Structures (bridges, overpasses, etc.)

2. Geographic area of coverage

3. Digital file format of the data: identify the main file format (AutoCAD DWG, Shapefiles, ArcGIS geodatabase, etc.)

4. Update process and frequency

- How current is the database?
-What is the update frequency?
-What sources are used for the update?
-Collect any available documentation about the update process

5. Mapping rules for road segmentation: identify the rules for breaking road segments (e.g., at intersections, overpasses, bridges, jurisdictional boundaries, etc.)

6. Request and gather any available database design/content documentation: formal data model defining entities and relationships, map feature lists, attribute content and format, physical database design documents, full data dictionaries defining the meaning of features and attributes, metadata documentation

7. Status of Linear Reference Models: Get any information available on the status of LRM definition

APPENDIX B: SURVEY FORM-SURVEY OF NEEDS AND FORMAT FOR ROAD-RELATED GIS DATA

Survey Form Page 1

Explanation and Directions:

This purpose of this survey form is to gather information about data needs and approaches for formatting GIS-based road centerline and associated attribute data. Please complete this form and submit your response electronically to Bruce Godfrey (bgodfrey@uidaho.edu) by October 22, 2009. If you have any questions about the survey please contact Bruce Godfrey or Dave Christianson (dchristianson@kcgov.us).

A. Organization Background Information

A.1. Organization/Dept. or Office: _____

A.2. Contact Name(s): _____

A.3. Phone: _____ A.4. E-mail Address: _____

A.5. What are your main GIS application needs for road data (you may check multiple boxes)?

☐ Transportation Map Generation ☐ Address Matching/Incident Mapping ☐ Emergency Dispatch/Planning

☐ Maintenance/Asset Management ☐ Route Planning ☐ Accident/Safety Planning

☐ Transportation Analysis/Planning ☐ Other: _____

A.6. Provide additional comments about your needs for road-related GIS data:

B. Road Type Priority

Indicate the importance or level of need in your organization for each type of road listed below. A score of "8" indicates that the feature is essential on a very frequent basis to support your business, and a "0" indicates that there is no need for this data element by your organization. In the space provided, include comments to elaborate on your scoring.

Type of Road	Priority (0 to 8)	Comments
Interstates		
State Highway		
County Highway		
Local/Municipal Street		
Roads on Federal Lands		
Private Roads		
Other:		

C. Positional Accuracy Needs

Check the appropriate box to indicate the maximum level of horizontal map accuracy for road centerlines that you require for your applications.

Accuracy Level		Explanation
Very High	☐	Within 1 foot or less from true position—obtainable through field survey or survey grade GPS data collection
High	☐	1 to 5 feet from true position—achievable through digitization from high-resolution orthoimagery
Moderate	☐	5 to 20 feet from true position—achievable through digitization from moderate-res. orthoimage or resource grade GPS
Low	☐	20 to 50 feet from true position—achievable from medium scale map or data sources (e.g., TIGER files, USGS Topo)
Very Low	☐	Greater than 50 feet

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D. Rules for Road Centerline Depiction and Segmentation

D1. Describe the rules that are applied or should be applied for depicting the centerline if divided roads (roads or highways with a center median):

D2. Check the boxes below to indicate the rules you apply or rules that you believe should be established for defining endpoints for centerline road segments (endpoints that define centerline segment features in the GIS database).

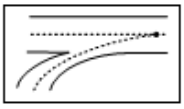
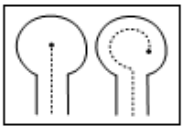
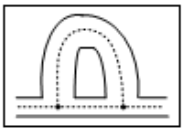
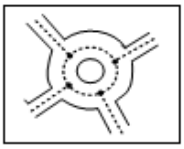
☐ Road intersections ☐ Jurisdictional boundary (type: _____)

☐ Change in road name or route number ☐ Zip Code boundaries

☐ Water crossing ☐ Other: _____

E. Rules for Handling Special Road Configurations

Explain any rules for road centerline delineation or segmentation for special road configurations.

Special Road Configuration		Explanation
Highway Ramps		
Cul-de-Sacs		
Loop Roads		
Traffic Circles		
Other		

F. Need for Road-related GIS Data

Check the boxes for road-related features that are of interest to your organizations.

☐ Site Addresses ☐ Mile Posts ☐ Traffic Signs or Signals ☐ Bridges/Overpasses

☐ Other: _____ ☐ Other: _____

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G. Road Centerline Attributes

Indicate the importance or level of need for attributes applied to road centerlines, A score of "8" indicates that the feature is essential on a very frequent basis to your organization, and a "0" indicates that there is no need for this data attribute by your organization. Add additional attributes in the spaces provided.

Priority (0 to 8)		Priority (0 to 8)		Priority (0 to 8)		Priority (0 to 8)	
	Segment ID (primary key)		Right From Address		Number of Lanes		Direction Traveled[8]
	Alternate Segment ID		Right To Address		Reverse Direction (Y/N)[2]		Jurisdiction of Road
	Primary Street Prefix		Left Postal ID		Divided Road (Y or N)		Surface Type Code
	Primary Street Name		Right Postal ID		Flip Geometry Flag[3]		Road Classification
	Primary Street Type		Left City		Left Side Odd (Y/N)[4]		Jurisdiction of Road
	Primary Street Suffix		Right City		Map Length[5]		Maintenance Status
	Route or Local Road#		Left County		3D Length[5]		Edit or Update Date
	Alternate Street Names		Right County		LRM ID[6]		GIS Data Steward
	Alternate Route #s		Right Community[1]		Beginning Log Point		Use Restriction
	Post Direction		Left Community[1]		Ending Log Point		
	Left From Address		Left Emer. Service Zone		Cardinal (Y/N)[7]		
	Left To Address		Right Emer. Service Zone				

Footnotes:

[1]Any community or place name different from FIPS municipality,

[2]Y means that ascending log points does not corresponding to direction of the segment geometry (digitized direction) in the GIS database

[3]Code to indicate that the geometry (digitized direction) of the segment should be flipped

[4]If Y, left side of street has odd number addresses, if N, left side has even addresses

[5]Map Length is length measured from a map source. 3D length is actual traveled distance (on which log points are based)

[6]The Linear Reference Model route number for the segment

[7]Y Indicates that the segment follows the standard rule for ascending log points (increasing W to E and S to N)

[8]One-way, One-way non-Cardinal (direction of travel is opposite that of log point progression), or Bi-directional

H. Update of GIS Road Data

If you are currently updating road centerline data, please briefly explain: a) main steps, b) software, c) source data for updates, d) type of roads you are updating, and d) frequency of updates. Feel free to include more detailed attachments or to use more space than is provided below if necessary.

I. General Comments

Provide any additional comments you have about the needs and format for road-related GIS data: